

MMM-A-187B
~~September 11, 1974~~
 SUPERSEDING
 Fed. Spec. MMM-A-187A
 March 20, 1968

FEDERAL SPECIFICATION

ADHESIVE, EPOXY RESIN BASE
 LOW AND INTERMEDIATE STRENGTH, GENERAL PURPOSE

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers two types of epoxy resin based adhesive for general purpose applications.

1.2 Classification. The adhesive shall be of the following types as specified (see 6.2):

Type I - Low strength, paste form.

Type II - Intermediate strength, paste or liquid form.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

Federal Specifications:

QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet.
 PPP-B-566 - Boxes, Folding, Paperboard.
 PPP-B-585 - Boxes, Wood, Wirebound.
 PPP-B-591 - Boxes, Shipping, Fiberboard, Wood-Cleated.
 PPP-B-601 - Boxes, Wood, Cleated-plywood.
 PPP-B-621 - Boxes, Wood, Nailed and Lock-corner.
 PPP-B-536 - Boxes, Shipping, Fiberboard.
 PPP-B-640 - Boxes, Fireboard, Corrugated, Triple-wall.
 PPP-B-665 - Boxes: Paperboard, Metal Edged and Components.
 PPP-B-676 - Boxes, Setup.
 PPP-C-96 - Cans, Metal, 28 Gage and Lighter.

Federal Standards:

Fed. Std. No. 123 - Marking for Domestic Shipment (Civil Agencies).
 Fed. Test Method Std. No. 141/GEN. - Paint, Varnish, Lacquer, and Related Materials;
 Methods of Inspection, Sampling, and Testing.

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, WA.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

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Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
 MIL-STD-129 - Marking for Shipment and Storage.

(Copies of Military Specifications and Standards required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

Federal Hazardous Substances Labeling Act:

Code of Federal Regulations, Title 21, Paragraphs 191.7 and 191.101

(Copies may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

American Society for Testing and Materials (ASTM) Standards:

D 1002 - Strength Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal).
 D 2393 - Viscosity of Epoxy Compounds and Related Components.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Materials. The adhesive shall be a two-part system consisting of a base polymer of the epoxy type with a suitable activator which when mixed as directed (see 3.9) shall produce an adhesive meeting the requirements of this specification. The two components of this adhesive in, the proper proportions for mixing, shall be furnished as a kit.

3.2 Form.

3.2.1 Type I (paste form). Both the base resin and curing agent shall be paste form, shall be opaque, and shall contain such pigments, inert fillers, and other modifiers as are required. The base resin and curing agent shall be of different colors and shall be so compounded that when equal portions by volume or by weight are mixed to a uniform color, the adhesive shall be ready for use. The color differences between the mixed adhesive and either base resin or activator shall be at least 5 NBS units when tested as specified in 4.4.5.

3.2.2 Type II.

3.2.2.1 Paste form. Type II paste form adhesive system shall conform to the requirements of 3.2.1 except that the mixing ratio is not limited to equal portions.

3.2.2.2 Liquid form. Adhesives in liquid form shall mix readily to a smooth solution or suspension of a consistency suitable for application and shall be free of lumps. The components shall not settle out during a working period of eight hours.

3.3 Solids. The complete adhesive system shall be free of volatile solvents, and the average nonvolatile matter in the adhesive system shall be not less than 99.5 percent when tested as specified in 4.4.1.

3.4 Setting and curing. The adhesive shall be capable of setting at room temperature, shall harden at a bond line temperature of 68° to 86°F. (20° to 30°C.), and shall cure at this temperature range within 24 hours. At a bond line temperature range of 153° to 164°F. (70° to 73°C.), the adhesive shall cure within one hour. Effectiveness of cure shall be determined by the requirements specified in 3.7.3.

3.5 Pressure. The adhesive shall be capable of making satisfactory bonded joints in conformance with the specification when only contact pressure is applied and maintained during the period of cure. Conformance to this requirement shall be noted in conjunction with tensile shear strength determinations (4.4.4).

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3.6 Pot life. A mass of 25 grams of the adhesive, when uniformly mixed and ready for use, shall remain spreadable at a temperature of $73^{\circ} \pm 2^{\circ}\text{F}$. ($23.1^{\circ} \pm 1.1^{\circ}\text{C}$.) for a minimum of 20 minutes.

3.7 Working properties.

3.7.1 Viscosity.

3.7.1.1 Type I and Type II (paste form). The viscosity of each component shall be such that it shall not run or flow from a tube without pressure or other physical force, but shall be readily extrudable or spreadable. Resin and activator shall conform to the requirements of 4.4.3.1 at acceptance and one year later.

3.7.1.2 Type II (liquid form). The viscosity of each component shall be within the range of 2,500 cps. to 25,000 cps. when tested as specified in 4.4.3.2.

3.7.2 Sagging (paste forms only). The uncured adhesive, when mixed and ready for use, shall not run, drip, or sag when tested as specified in 4.4.2.

3.7.3 Tensile shear strength.

3.7.3.1 Type I. The adhesive when tested in accordance with 4.4.4 shall have a minimum shear strength of 1,500 psi. when cured in accordance with 3.4.

3.7.3.2 Type II. The adhesive when tested in accordance with 4.4.4 shall have a minimum shear strength of 2,000 psi. when cured in accordance with 3.4.

3.8 Storage life. After the separate components are stored in the original unopened containers in ambient temperature of $75^{\circ} \pm 10^{\circ}\text{F}$. ($23.9^{\circ} \pm 5.5^{\circ}\text{C}$.) for one year after the date of manufacture, the adhesive shall meet the requirements of 3.6 and 3.7.1.1. The viscosity of Type II shall vary not more than + 10 percent from values in 3.7.1.2, and tensile shear strength shall be not less than 90 percent of values in 3.7.4. The manufacturer shall certify compliance with these storage life requirements.

3.9 Instruction sheet. The manufacturer shall provide instructions for use with each kit of adhesive. The instructions shall include the following information:

- a. Proportions by weight of components to be mixed, mixing instructions, including any controls necessary during mixing, and maximum usable pot life of the mixed adhesive.
- b. Application instructions, including spread method, number of coats, weight range, application temperature, and acceptable glue line (bond) thickness range.
- c. Typical time, temperature, for each segment of the complete curing cycle, giving minimum and maximum limits for each condition.
- d. Instructions for use of thinner and clean-up.
- e. Necessary safety precautions to be observed throughout all operations:
- f. Storage and handling instructions.

The instructions may be included as a separate sheet or may be incorporated into the kit label.

3.10 Workmanship. Each adhesive component shall be intimately mixed, homogeneous, and free from dirt, grit, lumps, skins, seeds, and other evidence of non-uniformity.

3.11 Kit sizes.

3.11.1 Type I and Type II (paste form). The base polymer and the activator shall each be furnished in the following unit quantities as specified (see 6.2). A unit quantity of one of each of the two components shall comprise a kit. The kit size shall be the sum of the volumes of the base and activator.

- 1/4 fluid ounce
- 3/4 fluid ounce
- 1-3/4 fluid ounces
- 1/2 pint can
- pint can
- quart can
- gallon can

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3.11.2 Type II (liquid form). The base polymer shall be furnished in the following unit quantities as specified (see c.2). A unit quantity of base polymer with sufficient activator in a separate container shall comprise a kit. The kit size shall be the sum of the volumes of the base and activator.

1/2 pint can
pint can
quart can
gallon can

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Sampling.

4.2.1 Lot. For purposes of sampling, a lot shall consist of all adhesive manufactured as one batch and offered for delivery at one time.

4.2.2 Sampling for inspection of filled containers. A random sample of filled containers shall be selected in accordance with MIL-STD-105 at inspection level I and acceptable quality level (AQL) 2.5 percent defective to verify compliance with this specification regarding fill, closure, and marking and other requirements not involving tests.

4.2.3 Sampling for lot acceptance. From each inspection lot, two containers of each component shall be selected at random. From each of the two containers, one pint of the material shall be taken and placed in separate, clean, dry metal or glass containers, sealed, marked and forwarded to the testing laboratory. Where packaging of the lot is in containers of less than one pint capacity, a sufficient number of the smaller size containers shall be selected so that the specified two one-pint samples of each component are available for forwarding to the testing laboratory.

4.3 Inspection.

4.3.1 Inspection of container. Each sample filled container shall be examined for defects of construction of the container and the closure, for evidence of leakage, and for unsatisfactory markings; each filled container shall also be gaged to determine the amount of contents. Any container in the sample having one or more defects or under required fill shall be rejected; and if the number of defective containers in any sample exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, the lot represented by the sample shall be rejected.

4.3.2 Inspection of preparation for delivery. An inspection shall be made to determine that the preservation, packaging, packing, and marking comply with the requirements in section 5 of this specification. Defects shall be scored in accordance with table I. For examination of interior packaging, the sample unit shall be one shipping container fully prepared for delivery, selected at random just prior to the closing operations. Sampling shall be in accordance with MIL-STD-105. Defects of closure listed shall be examined on shipping containers fully prepared for delivery. The lot size shall be the number of shipping containers in the end item inspection lot. The inspection level shall be S-2 with an QPL of 4.0 defects per hundred units.

TABLE I. Classification of Preparation for Delivery Defects

Examine	Defects
Markings (exterior and interior)	Omitted; incorrect; illegible; improper size, location, sequence, or method of application.
Materials	Any components missing or damaged.
Workmanship	Inadequate application of components such as incomplete closure of container flaps, loose strapping, inadequate stapling. Distortion of container, as applicable.
Contents (exterior container)	Number per container is more or less than required. Net weight exceeds requirements.

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4.3.3 Lot acceptance tests. The samples selected in accordance with 4.2.3 shall be subjected separately to the applicable tests specified in 4.4. If any one of the samples fails to pass any one of the tests specified, the lot represented thereby shall be rejected.

4.4 Test procedures.

4.4.1 Solids. Prepare approximately 7 grams of the ready-to-use adhesive by mixing proper proportions of base and activator which have been conditioned at $73^{\circ} \pm 2^{\circ}\text{F.}$ ($23.1^{\circ}\text{C} \pm 1.1^{\circ}\text{C}$) for 24 hours. The mixture shall be allowed to cool at $73^{\circ} \pm 2^{\circ}\text{F.}$ ($23.1^{\circ} \pm 1.1^{\circ}\text{C.}$) until exothermic reaction ceases. The specimen shall then be tested for nonvolatile matter by Method 4041 of Fed. Test Method Std. No. 141. Three samples shall be tested, and the average of the three shall be reported as solids in compliance with 3.3.

4.4.2 Sagging. Prepare smooth aluminum panels, 1" by 6" in size. The panels shall be clean, dry, and free of all dust, grease, and other foreign matter. To one side of the panels apply a 1/16" thick coating of the ready-to-use but uncured adhesive, hold the panel in a vertical position along the 6" axis. Any evidence of running, sagging, or film deformation shall be cause for rejection. Three panels shall be prepared and tested for conformance to 3.7.2.

4.4.3 Viscosity.

4.4.3.1 Type I and type II (paste form). Place a ten pound metal cylinder on a tube of resin or curing agent which is lying on a table horizontally with orifice open and uncapped. The edge of the weight should be approximately 3/4" from the extrusion end of the tube. At least 1" of the material shall be extruded in 30 seconds from orifice for sample to pass 3.7.1.1.

4.4.3.2 Type II (liquid form). Test for viscosity in accordance with ASTM D 2393.

4.4.4 Shear strength. Test for shear strength in accordance with ASTM D 1002. The following provisions shall be kept:

- a. Use panels of aluminum alloy 2024, T-3 temper, conforming to QQ-A-250/4, 1" by 6" by 0.064".
- b. Preparation of aluminum surface to be bonded:

Wash with hot soapy water; rinse thoroughly with hot tap water; immerse for 10 minutes at 30°C. in a bath of following composition by weight:
30 parts water, 10 parts sulfuric acid (sp. gr 1.84), 1 part sodium dichromate; use only a freshly prepared bath; rinse thoroughly with hot tap water; allow to dry; bond within 4 hours of surface preparation.
- c. Use overlap adhesive joint $0.5" \pm 0.01"$, with total adhesive edge not extending 1/4" more than the metal overlap distance.
- d. Mix adhesive according to 3.9.
- e. Apply adhesive with spatula to both metal pieces and immediately assemble with sufficient initial pressure to insure that maximum glue thickness does not exceed .015".
- f. Cure adhesive in assembly according to 3.4.
- g. Environmental conditions during adhesive mixing, application, assembly and shear test and for one hour preceding shear test, shall be $73^{\circ} \pm 2^{\circ}\text{F.}$ and $50\% \pm 2\%$ relative humidity.

4.4.5 Color.

4.4.5.1 Equipment.

- a. Drawdown blade - 2 inches wide capable of making a 0.003 inch wet film.
- b. Drawdown paper sealid - Leneta 250 or equivalent.
- c. Gardner Automatic Color Difference Meter AC - 3/CIE or any equivalent colorimeter capable of giving tristimulus values of X, Y, and Z.

4.4.5.2 Procedure. To a smooth, flat surface apply about 20 grams of the epoxy resin base in a mass about two inches wide, and with the doctor blade make a drawdown long enough for an instrument reading (approximately 4 inches). Do likewise for the epoxy hardener. Set the two drawdowns aside. To a similar surface apply the epoxy resin base and hardener, in proportions recommended by the manufacturer (see 3.2.1, 3.2.2.1, and 3.9), to make a total of about 20 grams of finished adhesive, mix thoroughly with a spatula until the color is uniform, then make a drawdown as described above with the doctor blade. The three drawdown are then read on the Gardner Color Difference Meter in terms of the tristimulus values X, Y, and Z. The calculations are determined by using the formula for "Unit of Color Difference" defined by covation B of NBS Circular (429, Photoelectric Tristimulus Colorimetry with Three Filters, by Richard S. Hunter, July 30, 1942. The color of the mixture is then compared to that of each of the two components for color difference.

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5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be Level A, B, or C, as specified (see 6.2)5.1.1 Level A.5.1.1.1 Unit packaging.

5.1.1.1.1 One quarter through 1-3/4 ounce. The base polymer or activator furnished in quantities of 1/4 through 1-3/4 ounces as specified in 3.11.1 shall be packaged in a close-fitting collapsible aluminum tube. One tube each of base polymer and activator of the same quantity comprising one kit shall be packaged together in a close-fitting box conforming to PPP-B-566, PPP-B-665, or PPP-B-767, with a partition. At the option of the supplier, the resin and catalyst may be packaged in a single collapsible aluminum tube with 2 longitudinal compartments, metered to provide for extrusion of correct proportions by volume of the 2 components simultaneously when the unitized tube is squeezed. The tube shall be provided with a secure metal or plastic cap of the threaded or clip-on type dependant upon tube construction. Each 2-compartment tube shall be considered a kit and shall be boxed accordingly. Alternatively, the adhesive may be packaged in plastic, compartmentalized, self-contained mixing kits.

5.1.1.1.2 One-half pint through 1 gallon. The base polymer or activator furnished in quantities of 1/2 pint through 1 gallon, as specified in 3.11.1 or 3.11.2, shall be packaged in a close-fitting can conforming with PPP-C-96, type V, class 2. One can each of the base polymer and activator comprising one kit, shall be packaged together in a close-fitting box conforming with PPP-B-636, class-weather-resistant. The 1 gallon size kit does not require packaging.

5.1.1.2 Intermediate packaging. Twelve (12) unit packages of kits of like descriptions in the 1/4 through 1-3/4 fluid ounce quantities shall be intermediate packaged in a close-fitting box conforming to PPP-B-636, class weather-resistant, grade W6c. The box shall be closed and sealed in accordance with the appendix of PPP-B-636.

5.1.2 Level B.

5.1.2.1 Unit packaging. The base polymer or activator furnished in quantities of 1/4 through 1-3/4 fluid ounces or the 1/2 pint through 1 gallon quantities, as specified in 3.11.1 or 3.11.2, shall be packaged in accordance with 5.1.1.1.1 and 5.1.1.1.2 except that the close-fitting box shall conform with PPP-B-636, class domestic, grade not less than 200.

5.1.3 Level C. The base polymer and the activator in the kit size specified shall be packaged to afford protection against corrosion, deterioration, and damage from the supplier to the initial destination. The supplier may use his commercial practice providing it fulfills the above requirements.

5.2 Packing. Packing shall be level A, B, or C, as specified (see 6.2).

5.2.1 Level A. The kits of like description shall be packed in close-fitting boxes conforming to PPP-B-585, class 3; PPP-B-591, class III; PPP-B-601, type III; PPP-B-621, class 2; or PPP-B-640, class 2, grade A. The boxes shall be closed and strapped in accordance with the applicable specification or appendix thereto. The gross weight shall not exceed 200 pounds.

5.2.2 Level B.

5.2.2.1 One quarter through 1-3/4 ounce. Six intermediate packages shall be packed in a box conforming with PPP-B-636, class domestic. Closure shall be in accordance with method I of the appendix of the box specification.

5.2.2.2 Half pints, pints, and quarts. Twenty-four unit packages of the 1/2 pint, pint sizes, or 12 unit packages of the 1 quart size shall be packed in a close-fitting box conforming to PPP-B-636, class-domestic. Closure shall be in accordance with method I of the appendix of the box specification.

5.2.2.3 One gallon cans. One 1-gallon can each of the base polymer and activator comprising one kit, shall be packed side by side in a close-fitting box, conforming with PPP-B-636, class domestic. Closure shall be in accordance with method I of the appendix of the box specification.

5.2.3 Level C. The kits shall be packed to insure carrier acceptance and safe delivery to destination in containers complying with the rules and regulations applicable to the mode of transportation.

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5.3 Marking.

5.3.1 Civil agencies. In addition to markings required by the contract or order, the packages and shipping container shall be marked in accordance with Fed. Std. No. 123.

5.3.2 Military agencies. In addition to markings required by the contract or order, the packages and shipping containers shall be marked in accordance with MIL-STD-129.

5.3.3 Other markings. In addition to markings required by the contract or order, those required by the Federal Hazardous Substances Labeling Act as applicable, and those required by 5.3.1 or 5.3.2, each unit and shipping container shall be marked with the date of manufacture of the adhesive contents by month and year, not by code, and with date of first reinspection. (Insert date 12 months after date of manufacture).

6. NOTES

6.1 Intended use. The adhesive covered by this specification is intended for use in the repair operations or in the bonding of metals, porcelain, ceramic materials, leather, wood and various porous and non-porous materials to themselves or to each other.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- a. Title, number, and date of this specification.
- b. Type and form of adhesive (see 1.2).
- c. Size and type of containers required (see 5.1).
- d. Quantity required.
- e. Level of packaging and packing required (see 5.1 and 5.2).
- f. Special marking required (see 5.3.3.).

MILITARY INTERESTS:Custodians:

Army - MR
Navy - AS
Air Force - 84

User activities:

Navy - OS, MC

Review activities:

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Coordinating activity:

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PREPARING ACTIVITY:

GSA - FSS

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(See Instructions - Reverse Side)

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

 VENDOR USER MANUFACTURER OTHER (Specify): _____

b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)

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